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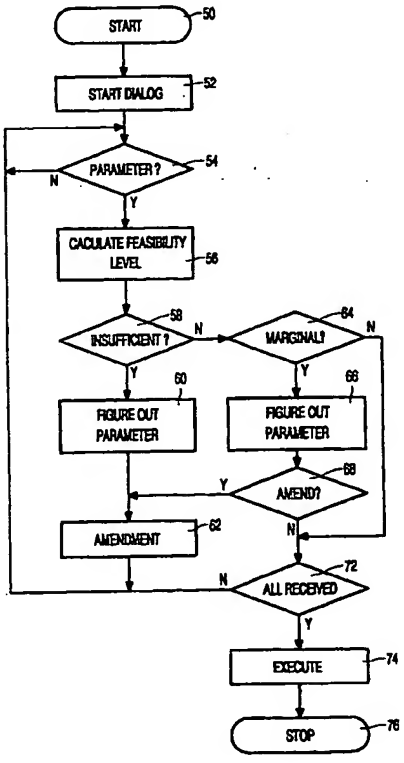
(54) Title: A CLINICAL XRAY BASED APPARATUS AND METHOD WITH DYNAMICAL SIGNALLING OF AN EXECUTION FEASIBILITY LEVEL DURING ENTERING OPERATIONAL PARAMETER VALUES



(57) Abstract: A clinical XRAY based apparatus with a user interface is operated by initiating the apparatus and then entering a sequence of operational parameter values for as based thereon executing an XRAY irradiation process. In particular, during the entering an execution feasibility level of the process is dynamically ascertained in view of an anticipated physical or other quantitative effect on one or more critical elements of the apparatus. Upon detecting insufficient feasibility, one or more parameter values already entered are figured out that have a preponderantly negative effect on said feasibility level and a user-initiated amendment of their value or values is allowed, until raising the feasibility level to sufficient. Otherwise the entering is continued until completing the sequence as preliminary to executing the XRAY irradiation process.

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A clinical XRAY based apparatus and method with dynamical signalling of an execution feasibility level during entering operational parameter values.

BACKGROUND OF THE INVENTION

The invention relates to a system as recited in the preamble of Claim 1. XRAY-based apparatuses are in wide use for diagnostic treatment, and in particular, but not limited to Computer Tomography Scanning. Before executing the measurements proper, an operator may have to select a variety of scan parameter values before the actual scan can be acquired. Inter alia because of the actual state of the apparatus, not all combinations of parameter values may be valid. The determining of whether a selected multi-parameter setting is feasible, represents a difficult task for a human operator, because of the following reasons:

- Certain parameters are interdependent, such as through limitations imposed on certain geometrical movements. Also, the duration and the intensity of the radiation combine to produce the actual radiation load.
- A particular aspect that is difficult to estimate is the dissipation load on critical elements such as the XRAY tube. The maximum incurred temperature is especially difficult to guess.

SUMMARY TO THE INVENTION

In consequence, amongst other things, it is an object of the present invention to allow the operator to dynamically anticipate the feasibility of a proposed radiation process, and in case the feasibility is too low, to amend the process in an early stage of the preparation thereof. In fact, if the feasibility level would be to low, the proposed irradiation could necessitate unforeseen wait times in order to let cool down the XRAY tube or other critical elements or other relaxation to occur. Various effects from outside could cause the XRAY tube to heat up, which herein is also called relaxation. Finally, in certain situations, the scan could even have to be aborted.

Now therefore, according to one of its aspects the invention is characterized according to the characterizing part of Claim 1.

By itself, US Patent 5,400,378 has a feedback mechanism to the apparatus for under influence of varying tissue attenuations adjusting the XRAY dose. In this way, irradiated persons may be subjected to less radiation than otherwise. In practice, the user

interface of the prior art apparatus would not signal this adjusting on the level of the irradiation parameter values for possible amending by an operator.

In contradistinction, the present invention is a procedure that affects the user interface in a dynamic manner, and in consequence, uses a calculated feasibility level of the process. In particular, the present invention allows to detect such problems in an early stage, so that mitigating steps could be taken, or alternatively, the process can be cancelled or directed to another, more powerful apparatus. In general, the present invention intends to greatly diminish delays that would be due to the trial and error setting of various parameter values in order to further improve the efficiency of the planning of scans.

The invention also relates to a clinical XRAY based apparatus arranged for applying the method as recited. Further advantageous aspects of the invention are recited in dependent Claims.

BRIEF DESCRIPTION OF THE DRAWING

These and further aspects and advantages of the invention will be discussed more in detail hereinafter with reference to the disclosure of preferred embodiments, and in particular with reference to the appended Figures that show:

Figure 1 is a pictorial view of a CT imaging system employing the present invention;

Figure 2 is a block diagram of such system;

Figure 3 is a flow chart explaining the present invention in more detail.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 is a pictorial view of a CT imaging system 10 for therein employing the present invention. Therein, gantry 12 has an XRAY source 13 that projects XRAY beam 14 towards detector array 16 on the opposite side of the gantry. Array 16 has a number of detector elements 18 that collectively sense the projected XRAYs that pass through clinical patient 15 who is resting on table 38. Each detector element produces an electric signal that represents its received XRAY intensity and, given the original XRAY intensity, an attenuation factor. During a scan to produce XRAY projection data, the gantry and associated components rotate about a center of rotation 19 that is located within patient 15. A reference detector not specifically shown at one end of array 16 measures the unattenuated beam intensity to detect non-uniformities in the applied XRAY dose.

Figure 2 is a block diagram of such a CT imaging system. Therein, the rotation of the gantry and the operation of source 13 are governed by control system 20. This mechanism comprises an XRAY controller 22 that provides power and timing signals to controller 23 that controls rotational speed and position of gantry 12. A data acquisition system 24 in the control mechanism samples analog data from detector elements 18 and executes A/D conversion. Image reconstructor 25 receives the digital XRAY data and executes image reconstruction. The reconstructed image is inputted into computer 26 for storage on mass storage device 29.

Computer 26 also receives commands and scanning parameters from an operator via user interface console 30 that may be provided with various input mechanisms, such as keyboard or mouse. User interface display 32 allows the operator to observe the reconstructed image and other data received from computer 26. The operator-supplied commands and parameters are used by computer 26 to provide control signals and information to the data acquisition system 24, to the XRAY controller 22, and to the gantry motor controller 23. Furthermore, computer 26 operates table motor controller 34 which controls motorized table 38 to position patient 15 in gantry 12.

In particular, computer 26 directs the various system components to carry out the prescribed scan in accordance with stored programs in dependency on a sequence of parameter values, such as angular or linear spacing between successive irradiation beams, irradiation time, XRAY energy, and various others that are well-known to persons skilled in the art.

In current systems, the validity of parameter values selected by the operator is only checked when all values have been entered and when the operator selects the next function that prepares the system for indeed executing the planned scan. At that instant, the system may signal an error message for warning that either the scan cannot be performed at all, or a warning message signalling that certain wait times will have to be introduced. Now, after receiving such error or warning message, the operator may want to change the parameters and repeat the procedure for inputting the various parameter values. Such is experienced by an operator as especially cumbersome, inter alia because a patient may actually be waiting on a table associated to the apparatus and further, because the patient will often have to be instructed about the process itself, such as on certain attitudes to assume, etcetera. However, this instruction should only been given when the planned scan has indeed been affirmed for execution.